

The development of the production of lithic industry in the Early Upper Palaeolithic of Moravia

Vývoj technologie výroby kamenné industrie na počátku
mladého paleolitu na Moravě

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On the basis of the refitting of chipped stone industry it has been possible to reconstruct and compare the reduction strategies of three prominent cultural complexes in Moravia during the Early Upper Palaeolithic. Thanks to such refitting, it is possible to describe the basic technological differences between the Bohunician, the Szeletian and the Aurignacian.

Moravia – EUP – refitting – technology – reduction strategy

Na základě skládanek kamenné štípané industrie se podařilo zrekonstruovat a porovnat operační schéma tří význačných kulturních komplexů na Moravě na počátku mladého paleolitu. Díky těmto remontážím jsme schopni popsat základní technologické rozdíly mezi bohunicienem, szeletienem a aurignacienem.

Morava – EUP – remontáže – technologie – operační schémata

1. Introduction

The method of refitting lithic artefacts has in recent years been much in favour, and as an approach has often been used in the reconstruction of the course of core reduction by knapping. This research method is applicable in particular to assemblages of stratified industry where, in combination with a suitable quantity of finds data, it enables the resolution of spatial and temporal questions of artefact distribution at a given site. From the point of view of technological analysis, it offers the most precise definition of the technological characteristics of a worked lithic industry, and also permits of the correct decipherment of several technological “pitfalls” in dealing with lithic industries, such as may be encountered from time to time in the classification of the latter.

Over several years, staff of the Anthropos Institute of the Moravian Museum have devoted themselves to the refitting of a collection of chipped stone industry obtained from the Museum’s own archaeological excavations: the Bohunician assemblage from Stránská skála III-1 and Brno-Bohunice I: Kejbaly (both excavated by K. Valoch), the Szeletian assemblage from the newly investigated site at Moravský Krumlov IV (excavated by P. Neruda & Z. Nerudová), and the Aurignacian assemblage from Vedrovice Ia (excavated by M. Oliva; *fig. 1*). The following description of the refittings from stratified and dated Early Upper Palaeolithic (EUP) assemblages demonstrates and compares the particular reduction strategy employed, and clearly describes the shift in technological development during the period of interest.

2. Description of the studied sites

Stránská skála III-1

Stránská skála is a fairly conspicuous Jurassic limestone cliff at the eastern edge of Brno (Slatiny cadastre), rising to a height of 310 m a.s.l. with a ridge that gradually falls off eastwards over around 1300 m to the road linky Slatina and the Líšeň quarter of the city. At the steepest, north-western section the limestone appears at the surface (in connection with recent mining), while the eastern and south-eastern parts are covered in Quaternary sediment strata of various thicknesses. It is with these areas in particular that finds-bearing layers containing Early Upper Palaeolithic artefacts are associated. In 1981, K. Valoch identified an extensive, particularly deep prehistoric feature, in addition to Palaeolithic artefacts, in the substrate of the latest fossil soil. After the excavation of a Funnel Beaker culture workshop (*Čižmářová – Rakovský 1983; Svoboda – Šmíd 1994*), excavation of the Palaeolithic layers began in 1982 in area III-1, where a Bohunician living floor was uncovered in three sectors (*Valoch – Nerudová – Neruda 2000*). This excavation was continued by the Archaeological Institute of the Czech Academy of Sciences in Brno at the same location (III), and other Bohunician stations – labelled II, IIa, IIIa, IIIb, IIIc and III-2 – were subsequently investigated (*Svoboda – Bar-Yosef eds. 2003*, 10).

Palaeolithic artefacts appeared primarily in the lower part of the duplex soil, and not infrequently also extended into the Ca-horizon on the surface of the loess substrate. Exceptionally, artefacts were also located in the upper part of the stratigraphy, which had been moved by gelifluction (SS IIIa; *Svoboda et al. 2002*, 134). The artefacts found during excavation of area III-1 were in various positions: some lay flat on their ventral surfaces, others at an angle or on their edges, and some even vertically. No detailed records of position were made, but no visible signs of the marked shifting or movement of the artefacts were observed; their vertical distribution in the layers covered some 20 cm.

In classifying the artefacts chronologically, it is possible to make use of the radiocarbon date $38\ 200 \pm 1100$ BP (GrN 12297; Moravian Museum excavations, area III-1; *Valoch – Nerudová – Neruda 2000*, 9).¹ From this it follows that Stránská skála was settled even during the period of the sedimentation of the Lower Würm loess, the upper part of which was changed by pedogenetic processes into soil (OIS 3a) during the Hengelo interstadial.

Moravský Krumlov IV

The site of Moravský Krumlov (MK) IV lies in the Krumlovský les (Krumlov Forest) region, well known for its occurrences of raw materials and the extraction of the particular type of chert named after it. This is very hilly terrain, with an axis running SSW-NNE, some 40 km south-west of Brno. The majority of the Palaeolithic sites concentrate on the eastern slopes, with divided by a series of valleys into distinct ridges facing SSE. It is on one of these, in the vicinity of prehistoric mining area 6 (*Neruda – Nerudová – Oliva 2004*) that the Palaeolithic site of interest was found, bounded to the south by a deep valley of Late Pleistocene or more likely Holocene age, and at which Quaternary sediments over 10 m

¹ For a complex overview of the absolute dating see e.g. *Svoboda 2001; Svoboda et al. 2002; Svoboda – Bar-Yosef eds. 2003*, 17.

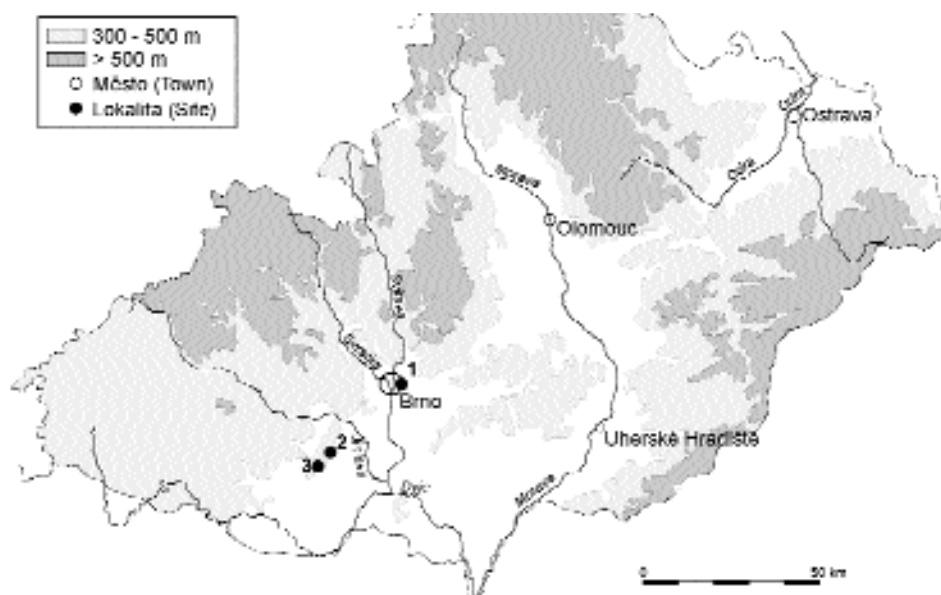


Fig. 1. Map of Moravia. Site locations: 1 – Stránská skála III; 2 – Moravský Krumlov IV; 3 – Vedrovice Ia.
– Obr. 1. Poloha lokalit: 1 – Stránská skála III, 2 – Moravský Krumlov IV, 3 – Vedrovice Ia.

thick were found. The height above sea level ranged from 315–325 m. The first finds that can be linked to this site were recovered in 1999 by M. Oliva; they comprised an interesting assortment of pre-cores on the north side of the track, which at this point cuts through intact loess sediments that were patently older than the surrounding prehistoric mining works. For this reason a probe was taken to ascertain the character of the layer and recover finds *in situ*. This showed that a group of 5 large pre-cores and another 2 flakes rested on the top of an interpleniglacial soil of Middle Würmian age. The loess overburden contained another flake made of Krumlovský les-type chert.

The year 2000 saw the partial deforestation of the surrounding area, and with it the local denudation of surface sediments. Thanks to this propitious turn of events, patinated artefacts appeared on the ground surface some 20 m west of the previous finds. The logical explanation that presented itself was that the cultural layer containing Palaeolithic finds here emerges at the surface; for this reason, the first excavation trench was opened here, labelled MK IV-1. Subsequent archaeological excavations in 2000–2004 discovered 3 Palaeolithic layers, which however – according to the most recent information gleaned – are earlier than the Middle Würmian interpleniglacial.

Another area, MK IV-3, lay some 15 m north of trench MK IV-1, and revealed the most complex stratigraphic sequence in the study area. In terms of the problems under consideration, a rich archaeological layer with a workshop character was an important discovery, this being linked to the Szeletian on the basis of the typology.

Artefacts (layer 0) were found in a slightly rusty pararendzina, covered by a thin layer of loess secondarily affected by biogenic processes. The soil substrate comprises a conspicuous solifluction horizon (E), followed by a loess complex (F, H, L) and soil layers (I, M;

Neruda – Nerudová – Oliva 2004). The pararendzina with artefacts, layer 0, shows signs of spatial shifting, but given the refittings possible it seems that from the point of view of artefact location it is possible to speak of para-autochthonic positions, as the refittings respect the concentrations found, or run across the vector of the slope. This fact may be explained by the planar sliding of whole blocks of soil resulting in overlapping deposits, as may be indicated by pararendzina sub-horizons divided by weak layers of precipitated CaCO₃ that more or less respect the angle of the upper soil layer. A para-autochthonous position may also be attested by the thickness of the archaeological layer, which did not exceed an average of 30 cm and was bound to the upper soil sub-horizon, and which did not extend beneath the detritic horizon that bounds it at that base.

Dating: The chronological assignment of layer 0 is somewhat problematic. As noted above, from the technico-typological perspective it seems highly likely that it can be classified to the Szeletian. The absolute dates obtained, however, are somewhat at variance with this: the radiocarbon dating of the rib of a young rhinoceros to $24\ 950 \pm \begin{smallmatrix} 570 \\ 530 \end{smallmatrix}$ BP proves little, given the low collagen content within the sample. This rib lay on the upper surface of the archaeological layer at the interface with loess, but even so is entirely outside the framework of the presumed dating.

It was for these reasons that samples were taken for dating by the Optically Stimulated Luminescence (OSL) method (L. Nejman & E. Rhodes, pers. comm.). The first sample (43 600 BP) came from the same level as the rib used for conventional radiocarbon dating. The second sample (64 600 BP) was taken from the base of the archaeological layer. These may delimit the age of the horizon, which varies between 43 600 and 64 600 BP. The average date is this 54 100 BP, which again is at variance to the previously defined temporal framework for the Early Upper Palaeolithic. The dating is therefore still a matter of enquiry (*Nerudová 2003a; Nerudová – Neruda 2004*).

Vedrovice Ia

The site of Vedrovice Ia lies NNE of the eponymous village, at an altitude of around 285 m a.s.l. (the Vanecka tract, plot no. 250), on the same ridge as the site of Vedrovice I, which lies 250 m to the north-west. To the south the terrain falls away to the horizontal loess drift on which the Vedrovice II station is to be found.

The site has been known from surface artefact collections since the end of the 1950s. In 1983 fossil bones, several flakes, cores and a high end-scraper were found in the backfill from laying telephone lines. It was for this reason that in the autumn of 1991 a test trench was arranged here at the point of the greatest concentration of finds, at the interface between the crown of the hillock and the slope leading towards the village. This probe identified Palaeolithic occupation at multiple positions (layers), and in the following year systematic, open-area excavation was therefore begun (*Oliva 1993*).

Geological bores were taken from the site environs, the purpose of which was to trace the course of the interpleniglacial soil and correlate the stratigraphic sequence with the surrounding Palaeolithic sites of Vedrovice I and II (*Neruda – Nerudová – Oliva 2004*).

Within the framework of the open-area excavation, a deep shaft was dug in quadrat 25–26/O-P, reaching down to the level of the underlying gravel-sand, and yielding a 7 m deep profile of the Quaternary sediments, which were detailed by a geological survey (*Havlíček – Neruda – Oliva – Smolíková 1997*). The main archaeological layers are represented

in the profile, although the division of the finds positions in the interpleniglacial soil was more apparent during excavation of the main area to the south.

Brown earthified braunlehms matching PK VII, or possibly older, are represented in the lower part of the deep trench. The subsequent, major sedimentary wear removed soil complexes PK VI-II and from this period only four loess horizons survived, of which the lower two are divided by aeolian sands (V-IX). The youngest of the soil complexes comprises two, weakly developed IV soils (the lower an arctic brown earth, the upper a pararendzina). Developmentally, these are two separate soils that may be genetically and on the basis of the finds associated with the Würmian interpleniglacial.

From the excavations on the main surface and the boreholes drilled, it follows that in a southerly direction the interpleniglacial soil projects to the surface, and is secondarily denuded first within the framework of the B-horizon and later in the ploughsoil. The present slope is cut through, so that south of this point artefacts of the primary station are found on the surface.

The preliminary characteristics of several of the finds horizons were set out by *M. Oliva* (1993). Archaeological layer 1, containing both Palaeolithic chipped stone industry and later (prehistoric) finds, is found in the recent B-horizon.

Layer 2, with isolated finds of chipped industry, appears in the light, possibly Upper Würmian, loess (geological layer III). The main archaeological layers (3 & 4) are found in the upper part of the brown fossil soil (later IV), at the absolute base of which was the not overly bountiful layer 5 (from the refittings carried out there is clearly not two, but only one archaeological layer). The industry in these layers is represented in particular by technical flakes, dechets and raw material fragments. Given the workshop nature of the industry found, there is a surprisingly small quantity of cores. Thanks to the advantageous chemical conditions (with a high degree of secondary calcification) even organ material has been preserved in the form of fragments of bone and horse teeth. These positions probably match the surface finds of chipped industry south of the point where the fossil soil secondarily becomes part of the recent soil complex.

In the loess sediment contained stray artefacts in its upper level (archaeological layer 6), with the chronological classification problematic.

Further down, in loess with a high fine detritus content and pebbles of Krumlovský les-type chert, lay the Middle Palaeolithic layer 7 (geological layer VI). The most characteristic find type was a fragment from a flake morphologically comparable to a Levallois point, but in addition there were also side-scrapers and denticulated tools. In contrast to the Aurignacian industry, the tools of the Middle Palaeolithic were in part made from Cretaceous chert (spongolite). This classification and the stratigraphic location imply a Lower Würmian dating of the layer.

Refittings of the chipped stone industry were carried out primarily on material from layer 3; it was subsequently shown, however, that a series of artefacts could be joined across layers 2–4. Even during the course of the excavation it was clear that southward the geological layer rose to the surface, and at the same layers merged that in the northern sectors had seemed to be inconspicuously divided by a thin sterile layer. Correlation of the information from the refittings and from spatial and stratigraphic analyses will in future prove more detailed information that will better specify the site chronology. Absolute dating will also be essential.

3. Description of the refittings

Stránská skála III-1

The site is located almost on top of a source of Stránská skála-type chert, but the assemblage nevertheless contains examples of quite a wide range of other types of raw material (*Valoch – Nerudová – Neruda 2000*, Tab. 7). Stránská skála-type chert appears here in several variants, and it cannot therefore be ruled out that they come from other sources (e.g. Švédské šance, Bílá hora), which however are also in the immediate area, no more than 2 km distant. Nodules, in which form the raw material occurs most often, break into small blocks due to the presence of frost fractures (the process of gelifraction); undamaged, compact nodules are in the minority.

Krumlovský les-type chert is found in cortical flakes, which attests to its transport in the form of pebbles or nodules. It is most often found used in hammerstones and retouchers, but the use of this material for the exploitation of blanks is debatable; it is however necessary to consider the heavily distorted opportunities for its determination caused by the heavy patination of artefact surfaces. Where the cortex does not survive, its differentiation from Moravian Jurassic cherts (including the Stránská skála-type) is difficult.

Radiolarite occurs in many coloured varieties, most often in a form lacking cortex. Flakes with cortex show that at least one block of raw material must have been brought in its original form from a primary source.

Spongillite (Cretaceous chert) appears in smaller numbers, and was evidently obtained from the gravel-sand terraces near the site (the Svitavy terraces), in the form of rounded blocks and pebbles. Erratic (glaciogenic) silicites and quartz appear in subsidiary quantities, and were used mainly as hammerstones in the form of pebbles.

One of the conspicuous features of the assemblage is the predominance of core residuals, typically of small dimensions, over pre-cores and exploited cores. This indicates a fairly intensive means of obtaining and working the raw materials, which everything suggests was not as simple as it might seem at the source.

After analysis of the refittings it can be stated that the main factor at play in the selection of the individual production method was the shape of the accessible raw material. The defined reduction strategies can be divided into three major groups: the sub-prismatic, the Upper Palaeolithic and the Levallois. The former pair may be taken together within the non-Levallois concept, while the Levallois has several variants related to the exploited supports, even while the principle of manufacture remains the same.

Non-Levallois cores were worked using different means, as has been described by P. Neruda (*Valoch – Nerudová – Neruda 2000*). The first is the sub-prismatic method², which concentrated on the processing of raw materials in the form of sharp-edged blocks. The aim was lessen the volume of the original raw material to the least possible degree, meaning that the raw material was virtually unprepared. Suitable frost surfaces were used as striking platforms, these exceptionally being prepared by one or two strikes. (*fig. 2; Valoch – Nerudová – Neruda 2000*, Abb. 34: 1; 35: 1; 36: 3; 45). The core exploitation

² In the original publication (*Valoch – Nerudová – Neruda 2000*) this method is described as a direct blade (non-Levallois) technique. Given that it was a simplified variant of the prismatic mode of core reduction, the simpler term 'sub-prismatic method' has been chosen instead.

surface was formed into a suitable shape by a series of preparatory blades with cortex. During exploitation the working surface of the core expanded the lateral convexity of the core, where the edge of the preceding negative, dorsal scar pattern was used to strike off further blades. Core re-preparation employed the opposite platform, often in the form of *outrépassé* (plunging termination) products. Only very infrequently were core striking platforms repaired. The unsuitable shape of the cross and longitudinal sections of the exploited surface was often dealt with by the use of the lateral part of the core to initiate a new working surface. Defects in the raw material were resolved by the re-orientation of the core, but where even remotely possible the core was exploited even in a state where the blanks obtained could not have any practical use.

The most conclusive refitting documenting the whole core reduction process is based on a sharp-sided block of Stránská skála-type chert (*fig. 2: 1*). The striking platform was formed by a natural frost fracture that met the future working surface at a convenient angle. The core was from the beginning conceived as being bi-directional. A natural crest blade joining the two striking surfaces was worked with just two inconspicuous strikes across the long axis of the worked piece of raw material (*fig. 2: 1a-b*), which cannot be regarded as a true working of the crest blade. A total of 7 blades (*fig. 2: 1c-i*) are known from the main striking platform, knapped in a series from right to left with the original natural crest blade struck off first. The series is interrupted by flakes struck from the opposite striking platform, the purpose of which was to repair the longitudinal convexity of the core (*fig. 2: 1j-n*). These are followed by a sequence of intentional final blades, again struck mostly from the main striking platform, which however could not be attached, as they were removed or otherwise worked later in the production process. The length of the surface of exploitation (*fig. 2: 1A*) was gradually reduced from 7.5 to 4.5 cm, with virtually no re-preparation until the removal of the final flake, which it was possible to mount (*fig. 2: 1n*). The advantageous shape of the raw material made possible serial exploitation without the use of technological finesse (re-preparation in the form of secondary crest blades or the rejuvenation of striking platforms). In this, the whole approach to manufacture differed from the other method. Blanks were struck off by direct percussion from a hard hammerstone, and it was therefore not necessary to abrade the proximal part (between the platform and the working surface).

A similar approach would have been used to prepare a non-exploited core, which had preserved across almost its whole surface the frost fractions, but which by its morphology was suited to these economical methods (*fig. 2: 2*).

The second, technologically better worked out method, was that of the Upper Palaeolithic blade core. Characteristically, this employs a crest blade to initiate the exploitation surface. Crest blades and secondary crest blades are abundant in the debitage and among the cores. The means of core exploitation is identical to that described above, but it is apparent that soft hammerstones were employed, and on several blanks abrasion of the proximal part is evident. Rejuvenation of the striking platform is more common, repeatedly before the knapping of further series of flakes or blades (*fig. 3: 1B*). The striking of several small flakes predominated, however, with very few tablets (rejuvenated striking platforms). Cores were abandoned in the extraction phase or after irreparable technological errors or raw material defects were identified.

In the refittings this technological approach is represented only exceptionally. None of the complex sequences are as complete as those of the preceding case. Given the pro-

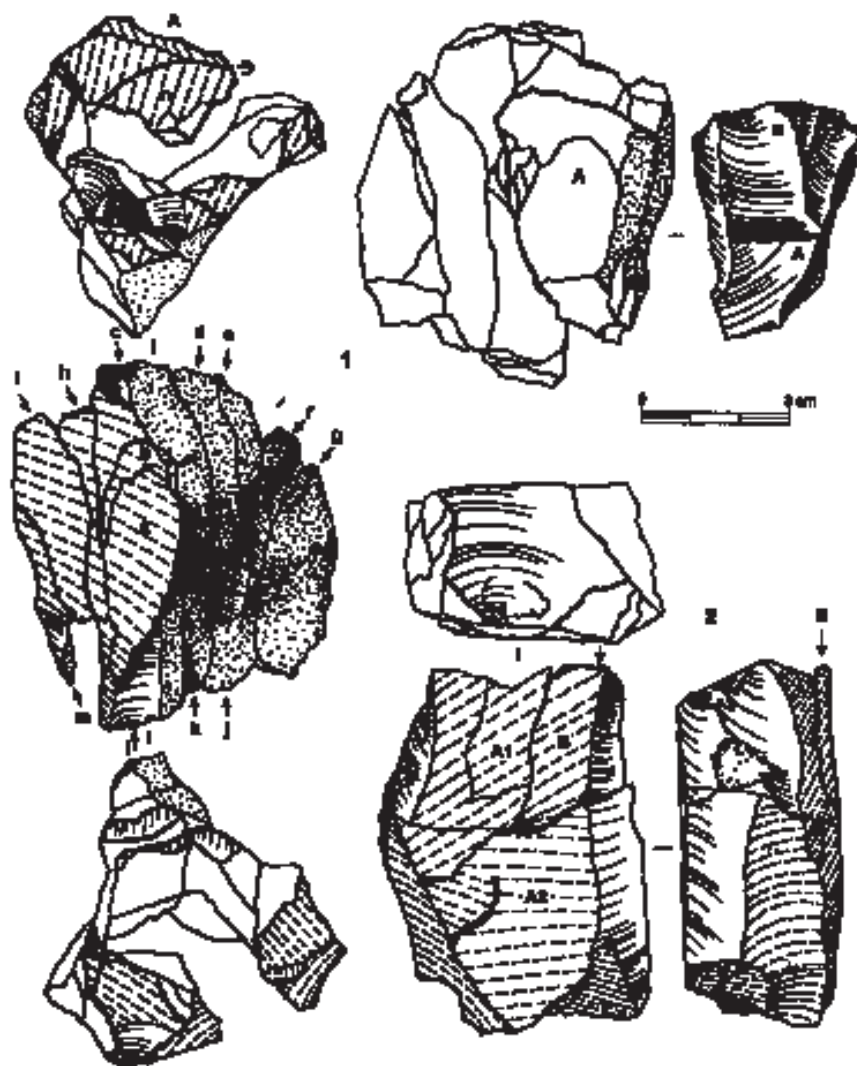


Fig. 2. Stránská skála III. The sub-prismatic method. 1 – refitting of a core (A) and flakes/blades (a-n); 2 – refitting of a core (A1+A2) and step terminated blade (B). – Obr. 2. Stránská skála III. Subprizmatická metoda. 1 – skládanka jádra (A) a úštěpů/čepelí (a-n); 2 – skládanka jádra (A1+A2) a čepel zaběhlé v těžní ploše (B).

nounced exploitability of the cores, approaches to the preparation of the raw material are not well documented. Their character is best attested by a prepared, non-exploited core with a worked crest blade on the narrow edge of a raw material frost fragment (*fig. 3: 3*).

In the refittings this approach is best shown by the refitting of a uni-directional core with a final blade and secondary crest blade that, within the framework of the core reduction, is evidently secondary (reparatory; *fig. 3: 2*). The original core (A) was larger, and primarily bi-directional. The removal of a series of flakes, however, changed the morphology of the

surface of exploitation in such a way that it was necessary to conduct re-preparation, from which the secondary crest blade (B) has survived; this had by removing the distal part successfully repaired the lateral convexity of the core. The success of this step is attested by a series of knapped final blades (surviving C).

Another approach to re-preparation is recorded in the refitting of a bi-directional core with a typical flake, repairing the striking platform (*fig. 3: 1*). The difference in the dimensions of the striking platform of the core (A) and the rejuvenation of the striking platform (B) attests to an ideal working angle, as from a striking platform made in this way it was possible to knap off two sets of the desired blanks. Before the rejuvenation of the striking platform, at least one series of blades had been taken off the core. The re-preparation of the distal convexity of the core was done in particular from the opposite striking platform, which was also repaired (C).

The Levallois reduction strategy made use mainly of high-quality raw materials, without frost cracking or other damage. Given that few preparatory steps are evident from the collection, raw material of a suitable shape – perhaps even with natural convexity – must have been preferred. Good preparation of the striking platform was important, whether only for the uni-directional reduction or for the bi-directional reduction of the core. With the exception of a single described core, which however served for another kind of knapping, neither careful preparation of the surface of exploitation nor preparation of the lateral part of the core in the early stages of working were apparent.

The result of such preparation is either non-standard Levallois debitage or debitage that in essence is not regarded as being Levallois. After the crude preparation of the core, the serial removal of blades, flakes or points followed, this being either uni-directional or, far more often, bi-directional (from two opposite platforms). After the removal of a series of three end products used for tool manufacture, the core was again prepared (re-prepared): for other serial Levallois reduction.

A specific group comprises cores that have surfaces yielding evidence of the use of multiple means of exploitation. This trend is well attested in particular in connection with the re-preparation of a Levallois core which, if its shape was not entirely suitable for further working (e.g. it was of small dimensions or contained defects), was re-oriented and exploited using a different method. The clearest evidence for such behaviour comes from refitting a Levallois core (*fig. 4: A*, stages a-b) with a Levallois point (*fig. 4: B*). After its removal there was an attempt at repairing the cross convexity of the exploited surface, which for some reason unknown inconvenienced the knapper. Either the subsequent blade was intended to rejuvenate the cross convexity of the core or this step may indicate the reorientation of the core to the edge (*fig. 4: 2C*), by which the side of the core would become a crest blade for the Upper Palaeolithic reduction strategy. Given that the edge was not suitably convex in the long axis, this led to a halt in knapping products on the future surface of exploitation. Another attempt at a similar reorganisation of the core was made on the opposite edge from the opposite platform. All of these attempts ended the same way, and so the core was discarded.

Moravský Krumlov IV

The assemblage of chipped stone industry from Moravský Krumlov IV has a distinctly 'workshop' character to it. Broken primary pebbles of raw material appear here, along with

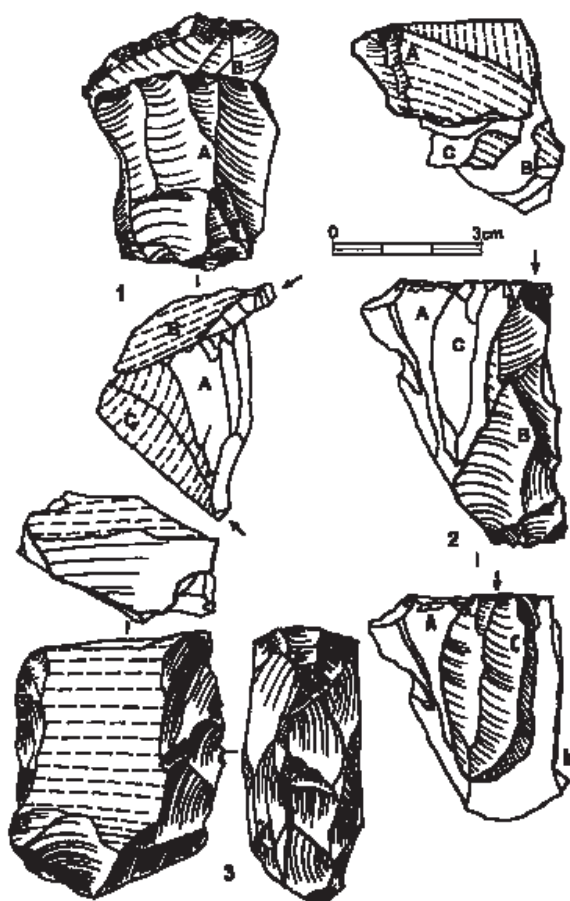
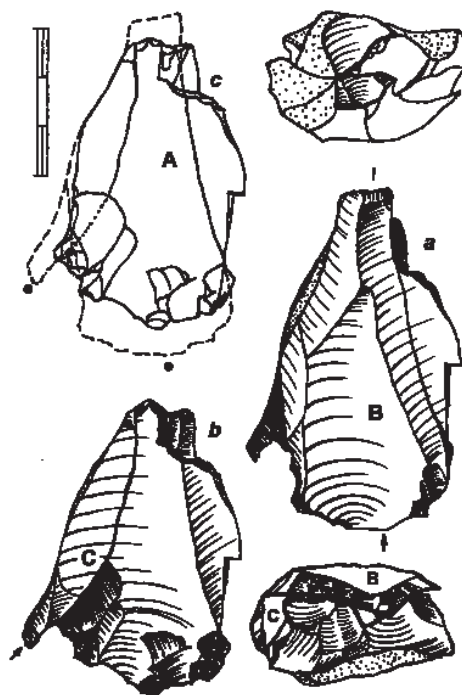


Fig. 3. Stránská skála III. The Upper Palaeolithic method. 1 – refitting of a bi-directional core (A) and striking platform rejuvenated flakes (B, C); 2 – refitting of a uni-directional core (A), secondary crest blade (B) and final blade (C); 3 – prepared core with crest. – Obr. 3. Stránská skála III. Mladopaleolitická metoda. 1 – skládanka dvoupodstavového jádra (A) a úštěpů obnovujících úderovou plochu (B, C); 2 – skládanka jednopodstavového jádra (A) a sekundární vodící hrany jádra (B) a cílové čepele (C); jádro s preparovanou vodící hranou.

cortex debitage and cores. The lithic industry has been markedly damaged by cryogenic processes, as is attested by the large number of refittings of frost-damaged artefacts. In addition to frost fractures, it has been possible to put together the entire *chaîne opératoire*, whether of individual flakes or in relation to residual cores. Three approaches to manufacture may be distinguished from the refittings of chipped stone artefacts carried out: the direct forming of artefacts (particular leaf points), the sub-prismatic method and the ‘discoid’ method (in the wider sense; not overly regular cores, without surface hierarchisation).

Refitting no. 1: An exploited core, the volume of which was partially reconstructed from the phase of breaking out the residual core to the first flake (*fig. 5: A*), which formed a striking platform (*fig. 5: N*). Considerable obstacles in exploiting the core include internal non-homogeneity and a hidden frost crack, which between them led to repeated re-orientations of the surface of exploitation. A massive flake with its entire cortex and drusy cavity (*fig. 5: B*) was extracted from the core striking platform created by one preparation flake. Several subsequent flakes are missing. From the opposite platform of the core another flake with a large part of its cortex was removed (*fig. 5: C*), which hid

Fig. 4. Stránská skála III. The Levallois method. Refitting of a core (A), Levallois point (B) and blade (C) preparing the transverse convexity of the core. – Obr. 4. Stránská skála III. Levalloiská metoda. Skládanka jádra (A) s levalloiským hrotem (B) a čepelí (C) preparující příčnou konvexitu jádra.



within it further non-homogeneities. The several flakes that followed are again missing, but from the surviving dorsal scar pattern there were probably two or three, all of which must have included cortex. The striking of these ended with another non-homogeneity. Another attached flake was knocked off along frost fracture (*fig. 5: D1*). The core was turned through 90° and several more blanks removed, as shown by the attached flakes (*fig. 5: D2, E*). The core was then turned through 90° again, and a whole series of shorter target flakes removed from the new striking platform, of which only two have been recovered, both with a striking platform remnant with cortex (*fig. 5: F, G*). The surface originating in the striking off of these flakes served as a new striking platform, the third in the sequence, from which at least three massive flakes (not recovered) were struck. After the striking of the last flake (*fig. 5: H*), the core residual evidently broke up, as there was no further exploitation.

As already shown, the whole volume of the pebble of raw material was shot through with non-homogeneities and rock crystal concretions. The intervening mass, however, is a very high quality variant of Krumlovský les-type chert, which the knappers made efforts to continue using through multiple re-orientations of the exploitation. The final flakes obtained were taken off site. The core residual and several flakes are, unlike the majority of examples from other lithic industries, lightly patinated.

Refitting no. 2: A simple core reconstructed from several artefacts (*fig. 6: N*). The broad striking platform was formed by the removal of two massive cortical flakes (*fig. 6: A, B*), after which further cortical flakes were struck off, these however running into a non-homogeneity in the mass of the core. Of these, only one distal part has been located (*fig. 6: C1*).

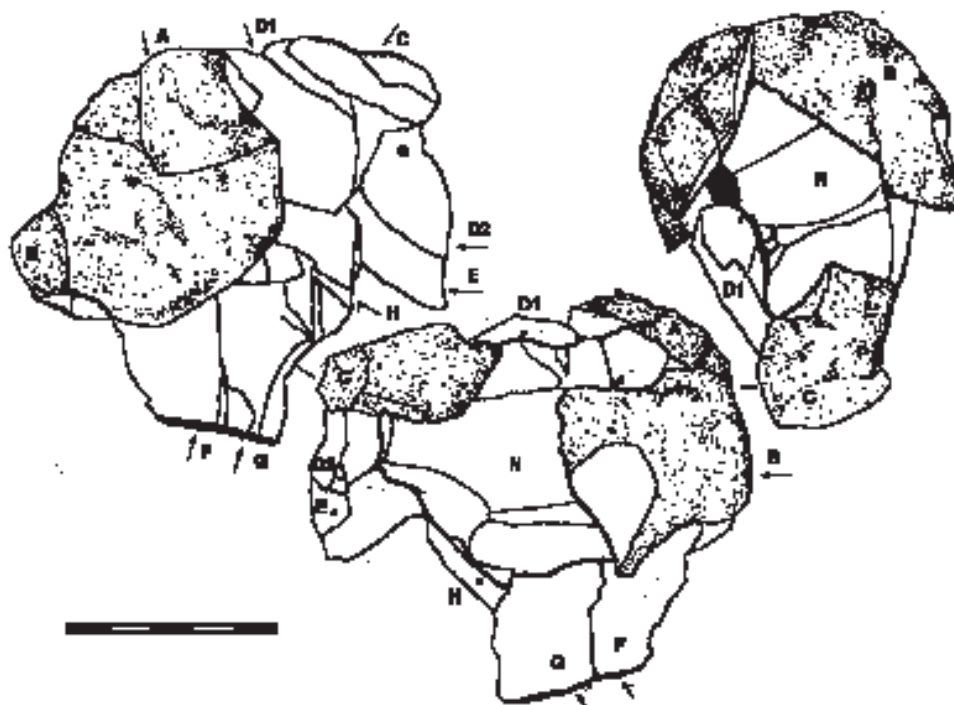


Fig. 5. Moravský Krumlov IV. The 'diskoid' method. Refitting of a core (N) and flakes (A-H). – Obr. 5. Moravský Krumlov IV. „Diskoidní“ metoda. Skládanka jádra (N) a úštěpů (A-H).

It has also been possible to attach two more flakes, one missing its proximal part (*fig. 6: C, D*). Both have parallel dorsal scar patterns and cortex on the surface. No other sequences were found. The back surface of the core shows frost flaking, of which several fragments could be re-attached.

Minor non-homogeneities in the raw material did not, in this case, prevent the further exploitation of the core. During such working, several nice, massive products were obtained, with parallel edges, of which some could subsequently be used as blanks for bifacial tools.

The sub-prismatic reduction strategy

Refitting no. 3: A massive preparation flake was knapped from a small pebble of chert raw material, giving rise to a broad striking platform. This striking platform preparation flake was subsequently retouched, becoming a bifacial side-scraper (*fig. 7: A1*), from which the bulb was removed and which thus cannot be confidently re-attached to the core (*fig. 7: N*). The character of the cortex, the dimensions and the raw material employed all made possible its inclusion among the refittings. The core was then worked around its perimeter; two cortical flakes were the first to be removed (*fig. 7: A, B*). This example differs from the cores exploited in a similar manner at Stránská skála in the approach used in the multiple treatment of the striking platform by a system of smaller flakes (other attached, elongated flakes have a pre-prepared striking platform: *fig. 7: D*). The compos-

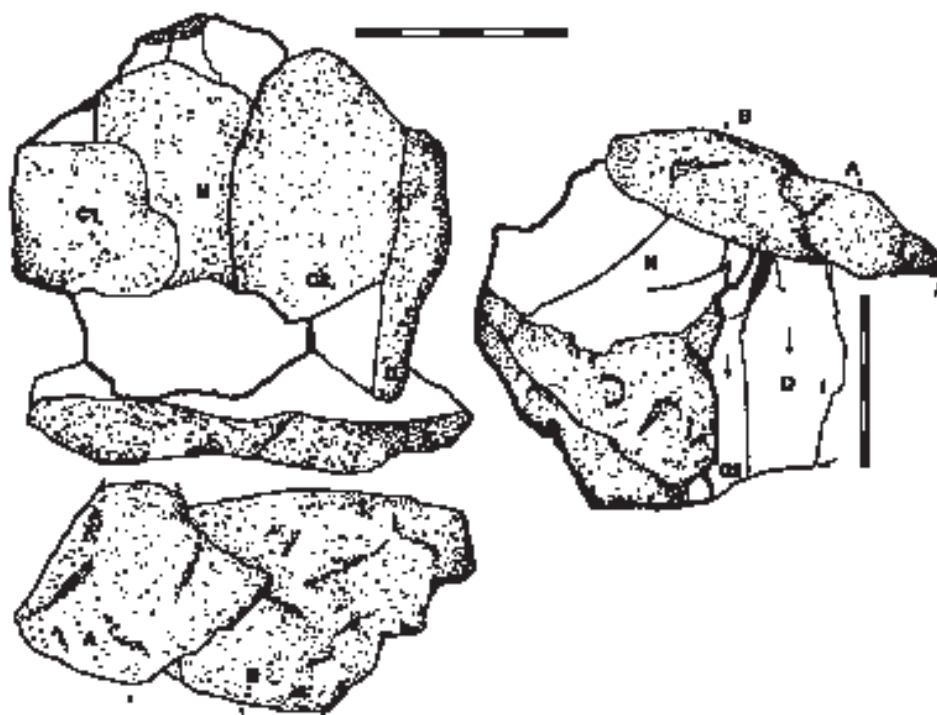


Fig. 6. Moravský Krumlov IV. Refitting of a core (N) and flakes (A-D). – Obr. 6. Moravský Krumlov IV. Skládanka jádra (N) a úštěpů (A-D).

ite core is included within this reduction strategy because the individual (final) flakes are knapped using direct blows from a hard hammerstone, without any preparation of the striking edge by abrasion, and in the absence of a crest blade and preparation of the distal part of the core (with a view to the longitudinal convexity). During working the flakes are therefore gradually cut, with step and hinge termination. The last of these was evidently intended to provide re-preparation, of course again very easy through the striking of a massive flake in a direction similar to the direction of exploitation. This led, however, to the *outrépassé* (plunging termination) flake taking with it a considerable part of the distal part of the core (fig. 7: 1), which considerably lessened the usable volume of the raw material. The core was then abandoned. Further fragmentation of the residual core was caused by frost action. A major part of the attached pieces from this core were found in a single quadrat, 11/R, which also held the greatest concentration of artefacts from within the study area.

Further evidence for the sub-prismatic reduction strategy is provided by the reconstruction of the process of core preparation with a sequence of blades. After readying the distal part of the worked piece by two blows to remove cortex (fig. 8: A1, A2), the natural crest blade (fig. 8: C) was struck to initiate an exploitation surface. This was followed by a series of blades (fig. 8: D-J), most with lateral cortex. Given that these remained preserved within the assemblage, it may be assumed that these were not carefully created blanks. The following series and the core could not be found and attached.

The first two refittings described provide a good illustration of the previously described technology of reduction applicable during the Szeletian (*Nerudová 2003b*). Most commonly, a single flake was struck from pebble raw material with the aim of creating a future striking platform. Without any further preparation, the core was then immediately exploited by a system of parallel strikes. Despite the simplicity of this method, even blades could be obtained in this way; the majority of the products, however, were flakes, sometimes relatively massive, and often with a semi-cortex, that could be used as supports for the production of tools. Attempts at core re-preparation are evident only where the nodule offered a finer type of raw material, similar in its qualities to erratic flint.

The abundance of low quality raw material in the immediate vicinity of the site resulted in a large number of cores, from which only a small number of products were chipped before they were abandoned (*Nerudová 2003b*, 81).

Direct artefact fashioning (*façonnage*)

Although through refittings it has been possible to reconstruct the methods by which cores were prepared and exploited, and there is evidence for the obtaining of common debitage, the main aim of all activities at the site of Moravský Krumlov IV-3 seems to have been the production of bifacial leaf points. The use of common debitage, in particular flakes (blade products appearing only sporadically: *Nerudová – Neruda 2004*), is not as yet certain, as retouched tools have thus far been found preserved only occasionally (e.g. a side-scraper on a core striking platform preparation flake, made from a uni-directional core, and an end-scraper; *fig. 7: A1*). Meanwhile, several refittings are apparently missing the final debitage (see refitting no. 1).

In this context, the types of blanks used for leaf points are surprising. While it might be presumed that these were common flakes or blades, the refittings imply that they were actually massive cortical blocks of raw material, with cortex remnants and frost surfaces, or half pebbles with one flat surface and one conspicuously bulging (an obvious core striking platform preparation flake, or even half pebble raw material). Even flakes loosened by frost action were usable for such a purpose, as indicated by the following refitting:

Refitting no. 4: A pebble of chert raw material broken into two equal halves along a frost fracture, within which was exceptionally high quality chert of the Krumlovský les-type. A “core” was prepared from one half (*fig. 9: 1A*) – which could of course also have been a pre-phase for leaf points like the second half (*fig. 9: 2*) – from which gradual working a bifacial object was formed (*fig. 9: 1CH*). Centripetal strikes were first used to remove the frost surface (illustrated flakes *9: 1A, B*); subsequently a single flake (*fig. 9: 1C*) was chipped from the cortical surface of the pebble, along with several semi-cortical flakes (preserved, and illustrated in *fig. 9: 1D*). The mass of the raw material was removed in particular from flat surfaces, alternately using two opposite, lateral sides (*fig. 9: 1F*). During this chipping the remainder of the pebble broke into three parts (*fig. 9: 1N1, 1N2*).

The second half of the frost-shattered pebble (*fig. 9: 2*) first had a striking platform prepared by short flakes, perpendicular to the frost surface (surviving flake in *fig. 9: 2A*). The back created in this way survives in the form of the prepared, backed side of a future bifacial tool. This was followed by the first reduction of the thickness of the object from the same edge, but to the cortical surface (*fig. 9: 2B-E*). Further reduction of the thickness

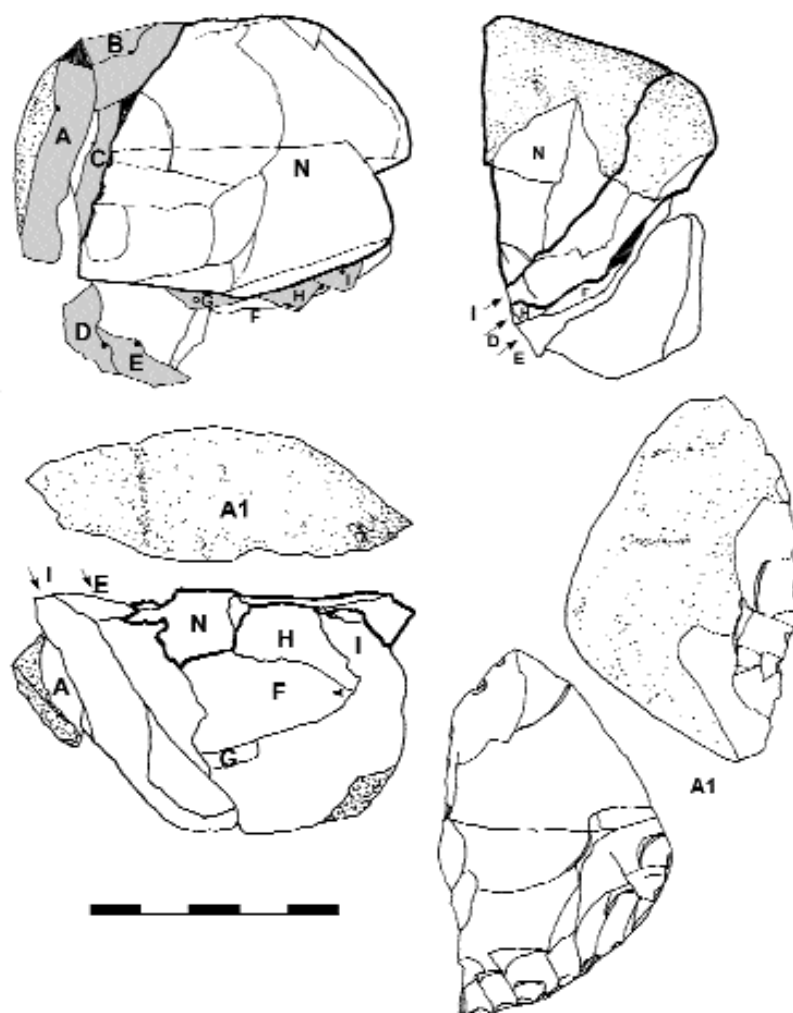


Fig. 7. Moravský Krumlov IV. The sub-prismatic method. Refitting of a uni-directional core (N) and flakes/blades (A-I); the striking platform initiated flake (A1) is used as the blank for a side-scraper. – Obr. 7. Moravský Krumlov IV. Subprizmatická metoda. Skládanka jednopodstavového jádra (N) a ústěpů/čepelí (A-I); vrchlík je použitý jako polotovar pro drasadlo (A1).

was undertaken using flat striking of the prepared back of the object (*fig. 9: 2F, G, H, CH*), and from the opposite cortical edge (not illustrated). It was through this knapping that an item was created that is typologically classified as a Middle Palaeolithic bifacial backed knife. This artefact was not, however, finished (*fig. 9: 2I*), for which there are several possible causes. In one of its parts two contiguous frost fractures are apparent, with a minor non-homogeneity nearby. It would have been clear to the knapper that to continue with the forming would break the item along these fractures, and the item was thus discarded before completion.

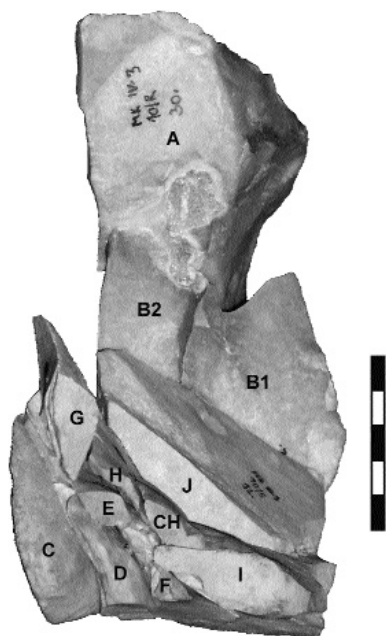


Fig. 8. Moravský Krumlov IV. The sub-prismatic method. Refitting of decortification flakes (A, B1, B2) preparing the distal part of core (not found) and a series of flakes (C-J), probably from the core extraction surface. – Obr. 8. Moravský Krumlov IV. Subprizmatická metoda. Skládanka dekortikačních úštěpů (A, B1, B2) preparujících distální část jádra (nenalezeno) a série úštěpů (C-J), pravděpodobně z těžní plochy jádra.

Both halves of the pebble were worked in similar fashion: first the knapper paid attention to the flat surface, and once this has been ‘cleaned’ of the frost surface preparation of the more massive cortical surface began. It is interesting to note that for the crude fashioning of the article, alternate striking on both surfaces to create the characteristic zigzag cutting edge was not used. In an effort at the minimal reduction of in particular the breadth of the item (given especially by the small initial dimensions), the knapper gradually thinned the side with the cortex using flakes into a surface, instead of using lateral preparation at the relevant point. Striking was done from opposite lateral sides, with no attention paid to the distal and proximal parts.

It was in this way that the coarse, bi-pointed, conspicuously plano-convex form of the future leaf point was created. This approach was employed on several leaf points despite the high degree of reduction of the ‘back’ (fig. 9: 2I). In several cases a preparation flake was removed from the opposite edge so intensively that it struck off a considerable part of the surface and the opposite lateral edge of the biface, as well as reducing the value of the knapping point. The application of this technique resulted in the plunging termination (so-called “bifacial thinning flake”; Nerudová – Neruda 2004) indicating that a biface was thinned at the site (Anderfsky 1998, 111).

After the removal of a “liquidation” flake, the remainder of the fassonage was abandoned, even if in one of the refittings there is evidence of the striking of one or two insignificant flakes afterwards. The approach described demonstrates the means of forming leaf points at Moravský Krumlov IV-3. Not in all cases, however, was the lack of completion caused by *plunging termination* (bifacial thinning flakes). With the exception of one or two pieces that remained undamaged, the cause of non-completion was the breaking of the object during preparation, thanks to internal frost fractures or during the removal of non-homo-

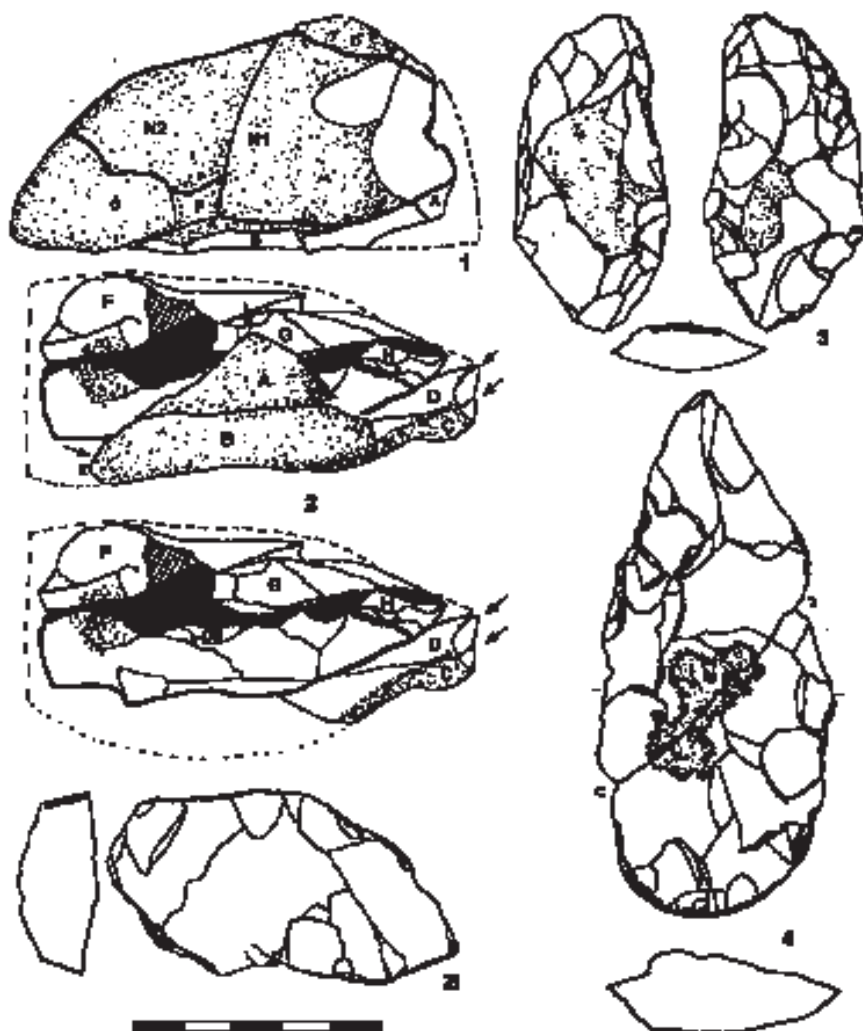


Fig. 9. Moravský Krumlov IV. The bifacial method. 1 – refitting of flakes (A-F) removing the cortex from half of the pebble (N1+N2), probably the initial phase of leaf point preparation; 2 – refitting of a bifacial tool (2I) and preparation flakes (A-CH). 3 – leaf point support; 4 – broken leaf point. – Obr. 9. Moravský Krumlov IV. Metoda přímého tvarování. 1 – skládanka úštěpů (A-F), odstraňujících kůru z poloviny valounu (N1+N2), pravděpodobně počáteční fáze preparace listovitého hrotu; 2 – skládanka bifacionálního nástroje (2I) s preparačními úštěpů (A-CH); 3 – polotovar listovitého hrotu; 4 – přelomený listovitý hrot.

geneities. Only one piece, perhaps, may be regarded as having been finished, this being made from a high quality, fine-grained Krumlovský les-type chert. In cross section this has a flattened, lentil shape, but it is not, unfortunately, symmetrical. This object has an intensive white patination (fig. 9: 3), and although there are no flakes known from its surface, it is such a characteristic, and in the assemblage exceptional, raw material that it can with confidence be stated that it was made directly on the site.

In conclusion, mention must be made of the reconstruction of part of the *fassonage* of a leaf point. A sequence of six subsequent preparation flakes (*fig. 10*) could be attached to a residual core or proto-beginning of a leaf point. The future leaf point was preliminarily shaped on just one surface; on the residual a remnant of the natural surface and, on the distal part, unremoved cortex are visible. The first three flakes, which were relatively short, did not cut into the whole of the prepared surface, but only halfway. These were followed by flakes of standard length, the fifth of which removed a considerable section of the distal, cortical part of the future biface. This was followed by six preparation flakes. It was not possible to attach further debitage, as is clear from the side view (*fig. 10: B*).

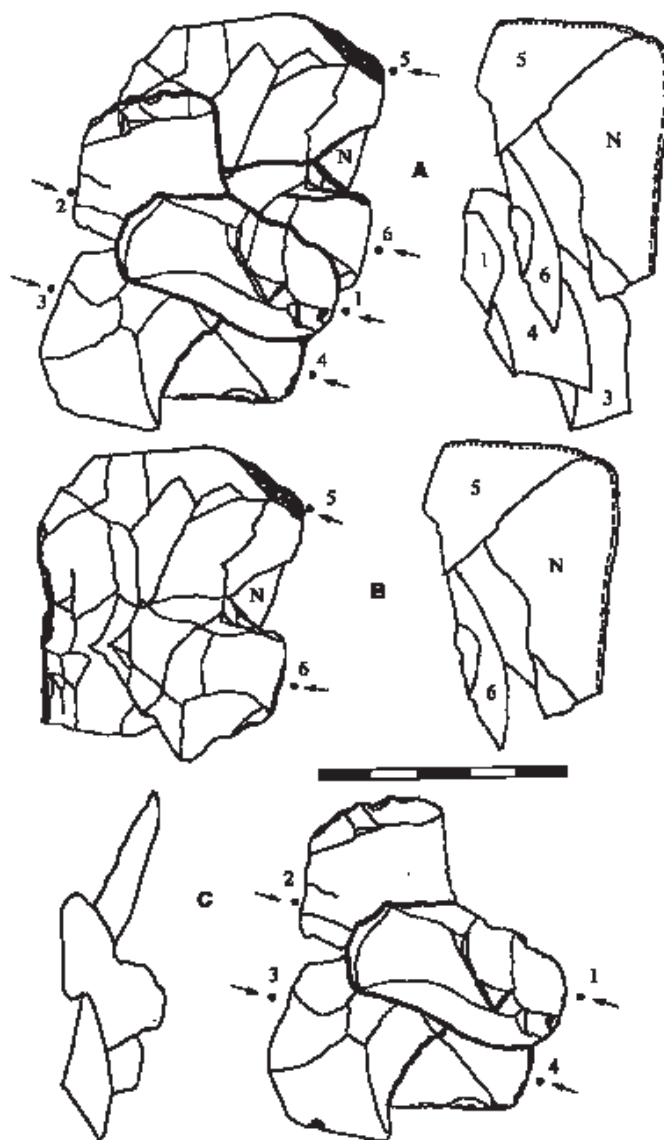
This method of the *fassonage* of leaf points was observed in several refittings. The future length of the points is given by the initial dimensions of the blank employed, and thus the reduction strategy concentrated on the other parts; initially a single surface is coarsely worked, while a second is left without preparation and often with cortex. Preparation of the surface is from to opposite (lateral) edges, always after a sequence of several flakes from one and then the other side. Once this phase is complete, the blank appears similar to a flat bifacial core. The future biface is then turned, and again bifacially reduced on the hitherto untouched surface. In this phase there is a marked reduction in the mass of the raw material, particularly in the lateral parts, as the angles under which the biface is prepared are often unsuitable (estimated 60–80°). After this phase, the future leaf point appears morphologically to be a bifacial backed knife (e.g. *fig. 9: 2I*), such as might be found in the Micoquian. Only after finer preparation, yielding thin preparation flakes, does it finish in the classic shape of a leaf point, such as is known from the Szeletian (*fig. 9: 3, 4*).

The main differences from the classic alternating means of shaping lie in the thinning of the worked piece of raw material, reminiscent of striking blanks from the broader part of the core surface. The striking platform in this case comprises the back of the artefact, from which broad flakes are chipped to create a surface. This method minimises the reduction of the width of the future bifacial tool – of particular importance with raw materials like Krumlovský les-type chert, the quality of which varies considerably and the more valuable pieces as raw material of which do not occur in large quantities. At the same time, the globular form of the original raw material (pebbles) is not ideal for the shaping of flat, bifacial artefacts. It was therefore necessary to strike off a larger flake that, given the shape of the pebble, was quite arched, making necessary a considerable reduction of the thickness of such a blank (schematic in *fig. 11*). In the case of the classic, alternating reduction strategy, there would however have been considerable reduction of the already limited dimensions of the support. The method used at the site of Moravský Krumlov IV-3, then, is an original solution to this technical problem; first there is basic removal of the cortex from the narrow side in the form of flat flakes, and the same time the steeper sides are prepared using short strikes into striking platforms (*fig. 11: A*). This gives rise to a shape with an asymmetric section (*fig. 11: B*), which forms the basis for the future reduction of the thickness by striking flakes in particular from the back of the artefact (*fig. 11: C*). In an ideal case it is this possible to create the more or less regular plano-convex cross-section of the leaf point (*fig. 11: D*).

Vedrovice IA

The composition of the chipped stone industry recovered again indicates that the excavated part of this site had a workshop function, with the difference that here there was

Fig. 10. Moravský Krumlov IV. The bifacial method. A-C – the sequence of flakes reducing the thickness of a broken bifacial tool (N). – Obr. 10. Moravský Krumlov IV. Metoda přímého tvarování. A-C – sekvence úštěpů, redukujících tloušťku zlomeného bifaciálního nástroje (N).



a greater representation of tools, relating to the settlement area located to the south of the workshop area. The collection contains a large number of cortical and preparation flakes, fewer blades and, given the overall number of pieces found, few cores. An interesting aspect in terms of comparison with the aforementioned site of Moravský Krumlov IV is the fact that both collections are manufactured from the same raw material, so that any technological differences would reflect real cultural differentiation.

The refittings undertaken show the use of a single technological approach to production (reduction strategy), based on the exploitation of Upper Palaeolithic cores with prepared

crest blades. This method is best illustrated by the refitting of crest blades, secondary crest blades and blades with lateral cortex, and a sequence of flakes rejuvenating the striking platform (tablet).

The core was exploited in the following manner: after careful preparation of the striking platform several flat flakes were prepared and struck off a single-sided crest blade (*fig. 10: A*); these were followed by two secondary crest blades with lateral cortex (*fig. 12: B, C*). After these first three blades, the striking platform was rejuvenated by flakes with a foot including the original striking platform with its natural surface (*fig. 12: D*). Another sequence of blades (*fig. 12: E, F, G*) were then removed, of which at least two had lateral cortex; the other blades are missing. The following strike was unsuccessful, because the flake remained in the exploitation surface (*fig. 12: H*). The next four cascaded tablets rejuvenated the striking platform (*fig. 12: I, J, K, L*), and must have produced blades, although none were found. The affixed crest blades and tablets were struck in the same direction.

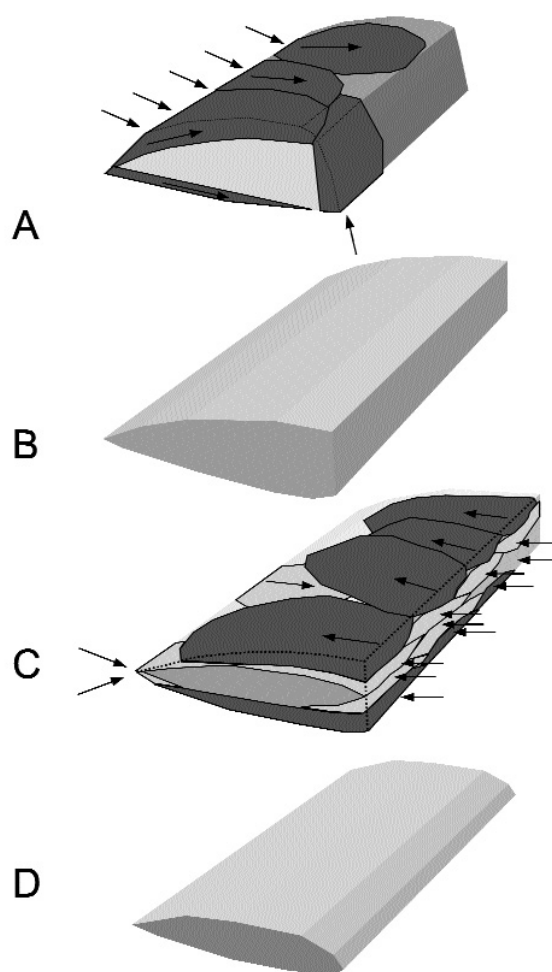
The exploited block of raw material was a peculiar type of Krumlovský les-type chert, grey in colour with a coarser but very homogenous, slightly porous structure.³ From the remnant of the natural surface (cortex) on the side of the refitting, the raw material seems to have been found in the form of a block of relatively large dimension. One of the longest blades, which however is not entire, measures more than 18cm. It was not possible to find either the residual core or the final debitage, represented by blades without cortex, with the exception of two basal sections of blades which, however, did not fit directly to the remainder. The first was a struck blade (*fig. 13: A1, A2*) that partially 'intruded' into the next blade; the next to be struck was blade B, the fracture of which at the point of striking is merely accidental (*fig. 13: B1, B2*). These products must have been carried beyond the area covered by the archaeological excavation, because given the character of the raw material such objects would have been readily identifiable.

Another refitting undertaken was comparatively simple – a bi-directional core with several preparation flakes. Within the framework of the preparation of an exploitation surface, a flake was struck with a non-prepared talon and lateral cortex, which however intruded into a frost fracture (*fig. 14: A*). This was followed by a massive flake, again with a non-prepared talon and partial cortex on the lateral side (*fig. 14: B*). This was used to prepare a striking platform from which several blade blanks were struck, as indicated by the arrows on *fig. 14*. For some reason this striking platform was then re-prepared, unsuccessfully – as is clear from the three short, overlapping negatives of dorsal scar patterns on the striking platform (with one exception the contrabulbs of the struck blades are not apparent). The core was therefore open to exploitation from the opposite striking platform, prepared by rejuvenation flake. Judging from several very short nicks with step and hinge termination in the striking platform, surviving on the core surface, it seems that this re-preparation was unsuccessful, and entirely devalued the exploited core – which was then discarded.

From the technological standpoint, it is significant that with the exception of both striking platforms and probably the crest blade, the shape of the core was not prepared in any complex manner; its back and side are partly preserved cortex and partly the natural glacial surface of the raw material. It can therefore be stated that in this case the prepara-

³ A survey of the raw material sources in the Krumlovský les region located such raw material only once, on the track linking the local village to the archaeological site, i.e. at a distance of around 200 m.

Fig. 11. Moravský Krumlov IV. The bifacial reduction sequence reconstructed after *fig. 9: 2*. – Obr. 11. Moravský Krumlov IV. Výrobní sekvence redukce tloušťky bifacionálního předmětu, rekonstruovaná podle *obr. 9: 2*.



tion and re-preparation approaches were practically limited to only to working a suitable striking platform (preparation of the crest blade cannot be demonstrated).

4. Summary

This article has described lithic industry refittings used by the authors to reconstruct the reductions strategies employed by three Early Upper Palaeolithic cultures in Moravia (*fig. 15*). The method of retrofitting the finds has aided in providing a detailed description of Bohunician technology, while for the Szeletian and Aurignacian similar data has not previously been available. The refittings from Vedrovice Ia, illustrating a typical Upper Palaeolithic reduction strategy in the Aurignacian, are regarded as having been particularly successful. The care with which the archaeological excavation itself was conducted has

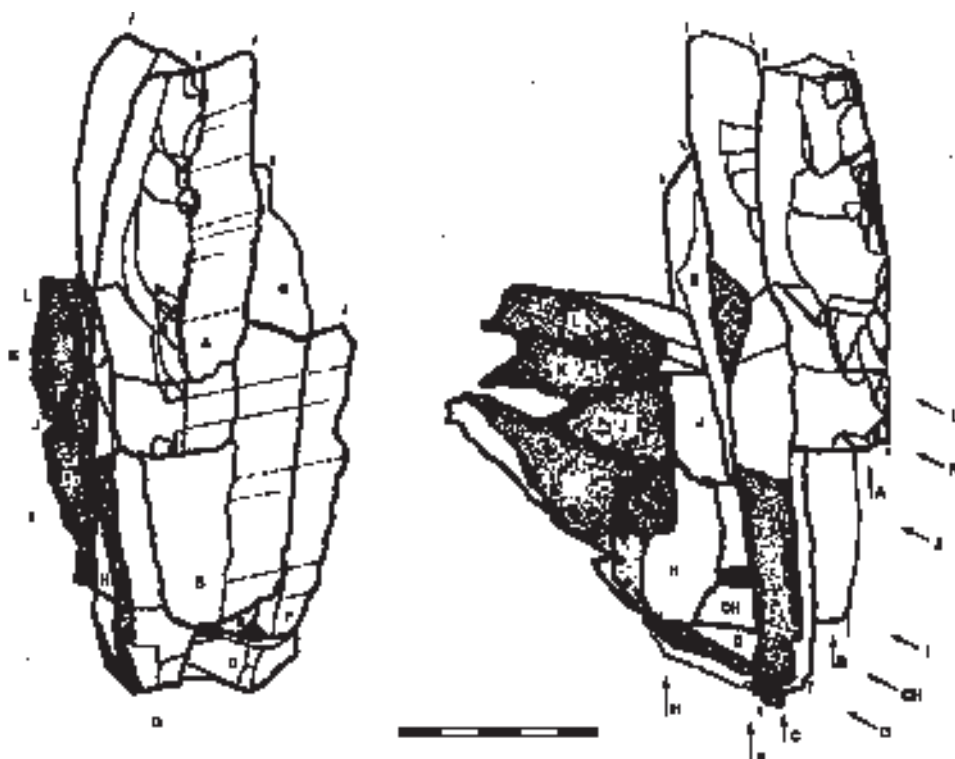


Fig. 12. Vedrovice Ia. The Upper Palaeolithic blade method. Refitting of blades (A-C, E) and flakes rejuvenating the striking platform (D, F-L) of the core (not present). – Obr. 12. Vedrovice Ia. Mladopaleolitická čepelová metoda. Skládanka čepelí (A-C, E) a ústěpů (D, F-L), obnovujících úderovou plochu jádra (nenalezeno).

reaped dividends, with numerous frost shattered fragments also having been collected and documented, their refitting contributing in so small part to the success (cf. Škrdla 1994, 7).

The technological composition of the reduction strategies of the Bohunician are highly diverse (fig. 15). Through artefact refitting it has been possible to define the three main directions that could be applied even to a single core. The system of production was aimed at obtaining various types of blanks, both Levallois and non-Levallois. These blanks are characterised by parallel edges, given by the means of striking; metrically of course they are often not blades, the production of which is not predominant (Nerudová 2002, 25; 2003b, 78). All types of the blanks obtained were used to produce tools. The simplest, sub-prismatic reduction strategy was applied in particular to sharp edged blocks of raw material with suitable angles between their surfaces, enabling the exploitation of blade blanks directly, without extensive alterations to the shape of the raw material. For striking, a hard hammerstone was particularly used for direct blows. In this way it was possible to separate relatively regular blanks from the core.

The Upper Palaeolithic reduction strategy is substantially more developed, with crest blades being prepared with several blows. This approach was also used for the re-preparation of the shapes of cores, and to separate blanks a soft hammerstone was employed.

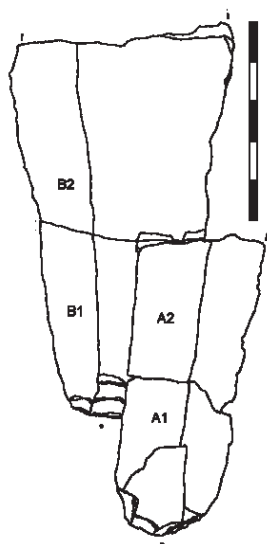


Fig. 13. Vedrovice Ia. The Upper Palaeolithic blade method. Refitting of blades belonging to the refitting on fig. 12 (not connected). – Obr. 13. Vedrovice Ia. Mladopaleolitická čepelová metoda. Skládanka čepelí, náležejících ke skládance na obr. 12 (nepropojeno).

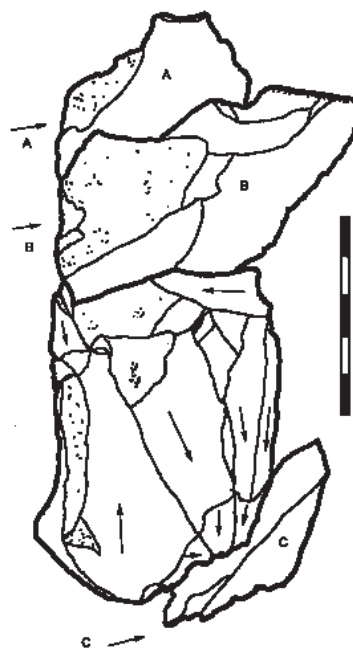


Fig 14. Vedrovice Ia. The Upper Palaeolithic blade method. Refitting of a bi-directional core and flakes (A-C) rejuvenating the striking platform. – Obr. 14. Vedrovice Ia. Mladopaleolitická čepelová metoda. Skládanka dvoupodstavového jádra a úštěpů (A-C) obnovujících úderovou plochu jádra.

The most characteristic feature of the Bohunician is the existence of the Levallois reduction strategy *sensu lato*. This method was used in particular to prepare cores from nodules of raw material. In preparing the shape, attention was centred on the striking platforms; the diagonal and longitudinal convexity of the core was altered only minimally, as often a suitable natural shape in the raw material was employed. Using a hard hammerstone, flakes, blades and points were struck from such cores, sometimes in series.

The combination of several methods on a single core is a separate issue. From the refittings carried out, it was possible to demonstrate the re-preparation of a Levallois core in the form of changing the orientation of the exploitation surface at the side of the core, and then using the Upper Palaeolithic reduction strategy. The individual methods are applied to the core in turn, but seem rather to have co-existed.

It is necessary to mention a somewhat different interpretation of this concept. From a neighbouring excavated area (Stránská skála IIIa) it was possible to undertake several very complex refittings. Some of the Levallois cores used a crest blade to initiate and exploitation surface (the Upper Palaeolithic reduction strategy, cf. Svoboda – Škrdla 1995, fig. 29.5). The combination of Levallois and Upper Palaeolithic knapping methods led to consideration of a fusion between the two being a characteristic of Bohunician technology (e.g. Svoboda – Škrdla 1995, 435). In contrast to the three different methods of striking

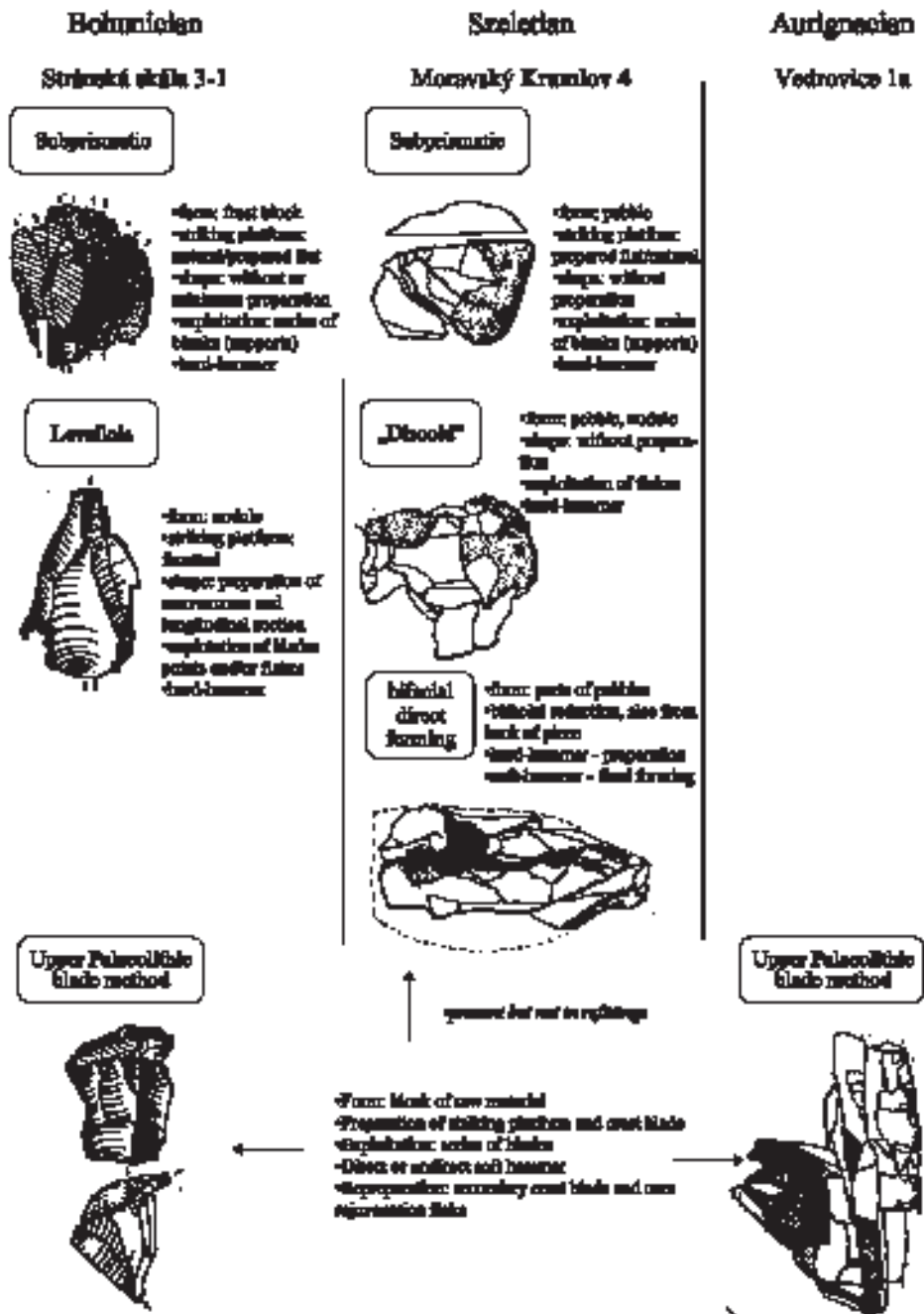


Fig. 15. The variability of lithic reduction strategies, reconstructed after refittings from mentioned Early Upper Palaeolithic sites (scheme don't record entire variability of methods). – Obr. 15. Variabilita výrobních metod, rekonstruovaná podle skládanek ze zmíněných lokalit z počátku mladého paleolitu (schéma nezachycuje úplnou variabilitu metod).

outlined here, P. Škrdla explains the presence of Upper Palaeolithic and prismatic uni- and bi-directional cores thusly: cores were often prepared as Upper Palaeolithic cores with crest blades and exploited in the Bohunician fashion, leaving a residual core that appears to be a discoid Levallois core on a flake (Škrdla 2003a, 65ff). He characterises the Bohunician technology in the following words: “The reconstructed sequences [e.g. no. S01/84 from SS III-a (Škrdla 2003a, fig. 9.2)] represent the fusion of Levallois and UP reduction strategies. Raw material was prepared as UP crested core. The serial production of Levallois points together with blades continued” (Škrdla 2003b, 139).

The question arises, however, as to whether this was a standard in terms of reduction strategy, or whether it was one of several production variants. If there was truly a fusion, then this core reduction strategy should predominate. Refittings from area III-1, however, do not as yet confirm such notions (which does not mean that they could not have been present here), and even from area III-2 the illustrated refittings show perhaps just two obvious examples of fusion, with the contemporary occurrence of crest blades and the volume mode of exploitation. On the other hand, it is possible to demonstrate the independence of the Upper Palaeolithic methods in the course of exploitation (Valoch – Nerudová – Neruda 2000, Abb. 34: 1, 2), from which it may be adjudged that at least in some cases core exploitation took place within the framework of a separate approach to manufacture.

Another associated problem is the general question of the discovery of blade production and its interpretation. Blade production on the Levallois method can be found in Würmian Middle Palaeolithic collections (Secline, Rocourt etc.), as can the first evidence of the serial exploitation of non-Levallois blades (in the Czech milieu described heretofore as the sub-prismatic reduction strategy). The situation is complicated by, for example, the fact that the Levallois blade method controls the cross convexity of the core by use of the side-struck blade (*lame débordant*), which morphologically is often similar to the core crest blade, and its interpretation is not straightforward (see the edge of refitting S08/84: Škrdla 2003b, fig. 9.3).

Differences in the descriptions of industries are to a considerable extent created by somewhat different terminologies, and by differences in understanding the significances of the phenomena described.⁴ In the final analysis, however, the conclusion can be drawn from both conceptions that the flexible, variable use of several production methods, the choice of which was determined either by the quality of the raw material or the morphology of the core, is a characteristic trait of the Bohunician reduction strategy. The advantage of this method was the marked exploitability of a block of raw material. Given the foregoing, Bohunician technology may be described in broader terms as the “co-existence of methods”, because it would seem to the authors that this best encompasses the technological variability preserved in the refittings.

The Szeletian reduction strategy (*fig. 15*) from the studies site may be divided into two main directions: the production of leaf points by direct fashioning (*fassonage*), and the exploitation of simple cores of either the sub-prismatic type or essentially similar to Middle Palaeolithic discoid cores.

⁴ For example, the core remnant (h) from refitting S01/84 is not regarded by the authors as discoid (Škrdla 2003b, 122), because they believe it to be a typical relict of a Levallois core with traces of parallel exploitation and a negative left by the striking of a preferential flake that ended exploitation of the core.

The sub-prismatic method of core reduction is based on the creation of simple striking platforms by the striking of the first cortical flake from raw material in pebble form. This is followed by a series of flakes from the striking platform, which in some cases match blades and which are separated from the core by direct blows from a hard hammerstone.

The second, debitage method, exploited raw materials in a manner comparable to the Middle Palaeolithic discoid cores. Certain divergences appear in the existence of multiply re-oriented cores, and in the existence of a series of struck blanks. Both approaches yielded more or less standardised blanks that were subsequently commonly used to manufacture retouched tools (including for example leaf points or bifacial side-scrapers from the first preparatory flake of the future core).

In contrast to the preceding cultures, the Aurignacian reduction strategy is characterised by its uniformity. Refittings of lithic artefacts from the site at Vedrovice Ia permitted the identification of only one method of core reduction, which can be termed Upper Palaeolithic. It is marked by the careful preparation of the striking platform on the core, which is always prepared – in contrast to the observations of *P. Škrdla (2003a, 70)* on material from Stránská skála – and the preparation of the crest blade. Control of the angle between the striking platform and the exploitation surface maintains the lateral convexity of the core. Core backs are generally not prepared, or at least were not prepared in the examples described here. The distal convexity of the core is prepared at the moment when exploitation of the core needs to be reoriented to the opposite striking platform. Regular blade blanks are taken from the uni- or bi-directional core by direct blows from a soft hammer (e.g. antler billet). The most characteristic phenomenon may be seen as the repeated re-preparation of the striking platform by the knapping of ‘tablets’ rejuvenating it, precisely controlling the angle between the exploitation surface and the striking surface, but at the same time markedly reducing the length of the worked raw material. It seems that this approach can be regarded as common in Aurignacian technology (*Chiotti et al. 2004, 284*). Technological success is attested by the exceptional refitting of prepared and final blades with flakes (‘tablets’) rejuvenating the striking platform, evidence of the extraordinary skill of the knapper even faced with coarser, less high quality raw material; in other words, the technology employed was not influenced by the quality of the raw material, as was the case in the two preceding cultures. In future it will perhaps be possible to distinguish two variants of the Upper Palaeolithic reduction strategy, which yielded blade blanks of somewhat different morphology. On the one hand there are direct blades with a conspicuous ridge (lip) at the ventral face of the striking platform, while on the other are blades of smaller dimensions that are strongly curved; the talons of the latter are plain or dihedral, and again have obvious ridges (lips). The possible co-existence of two techniques (the direct and indirect) of obtaining blade blanks was suggested by *M. Oliva (1984, 606)* on the basis of an assessment of the lithic inventories from Moravian Aurignacian stations in relation to the results of experimental analyses (*Bordes 1947; Bordes – Crabtree 1969*).

The results obtained by this study, which define the technology employed in the exploitation of lithic artefacts at the three sites described, are extremely important for a more precise definition of the relationship between the Early Upper Palaeolithic cultures in Moravia. The question remains, however, as to what extent it is possible to generalise from the technological characteristics defined, i.e. whether the approaches used at other sites were similar at least in intention. At the very least, in the case of the Szeletian it is necessary to

assume a certain variability linked to site location in relation to the sites of other cultures (the Bohunician in the Brno region) and to site function. The Szeletian collections closer to the contact zone with the Bohunician also contain Levallois cores and blanks, which do not appear at all in the Szeletian assemblages from Moravský Krumlov IV or Vedrovice V. The autochthonism of these components must be further researched by the refitting of Szeletian assemblages that contain Levallois elements; no suitable assemblage is presently available, however. The existence of the sub-prismatic and 'discoid' methods in the Szeletian may be taken as a fairly common phenomenon, which must be connected to the possible origin of this culture in the Micoquian. The existence of the method of the direct fashioning (*fashionage*) of bifacial artefacts is again a general trait that is moreover a primary criterion of definition.

Bohunician technology is, given the quantity of sites investigated using modern methods, among the best researched. The individual methods recur at workshop sites. The technological composition at, for example, Brno-Bohunice itself, is somewhat different, with the frequent occurrence of raw materials other than Stránská skála-type chert (Krumlovský les-type chert, spongolite etc.), and at the same time methods of direct fashioning (*fashionage*) appear in conjunction with the production of leaf points. This is essentially the antithesis of the problem of the Levallois reduction strategy in the Szeletian. In the future it will be necessary to ascertain to what extent it is possible to assume the production of bifacial tools at non-workshop Bohunician sites (*Nerudová – Neruda 2004*).

A non-homogenous impression is given by Aurignacian technology. The defined approaches recur several times in a number of refittings, so within the framework of the study site they may be regarded as a common phenomenon. Unfortunately, other comparable assemblages are not available at the present time. From the analysis of industries elsewhere in Europe, however, it would seem that the principle of the repeated rejuvenation of striking platforms and the preparation of core crest blades will prove to have been a general mark of Aurignacian technology, which will also locally contain specific approaches and variations. It appears that from the technical perspective it is necessary to assume at least two variants, a specific component comprising the striking of small bladelets from end-scrapers and grooved burins, in particular in assemblages containing microlithic Dufour or Krems bladelets (*Demidenko 2002*).

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Vývoj technologie výroby kamenné industrie na počátku mladého paleolitu na Moravě

V předloženém příspěvku autoři popisují skládanky kamenné industrie, které následně využívají pro rekonstrukci výrobních postupů u tří časně mladopaleolitických kultur na Moravě (*obr. 15*). Metoda zpětného skládání nálezů pomohla podrobně popsat technologii bohuničieniu, zatímco pro szeletien a aurignacien jsou získané údaje v kontextu paleolitického bádání u nás novinkou. Zejména skládanky z Vedrovic Ia, ilustrující již typicky mladopaleolitický způsob sbíjení v aurignacienu, můžeme po-

važovat za velmi úspěšné. Vyplatila se také pečlivost, s jakou byl veden již samotný archeologický výzkum, při němž byly odebírány a dokumentovány i četné mrazové zlomky, jejichž skládání také nemalou měrou přispělo k celkovému úspěchu.

Velice pestrá je skladba technologických výrobních postupů v bohunicieniu (*obr. 15*). Skládáním artefaktů se podařilo definovat tři hlavní směry, které mohou být uplatněny i na jednom jádře. Systém produkce je zaměřen na získávání různých druhů polotovarů: levalloiských i nevalloiských. Pro tyto polotovary jsou charakteristické paralelní hrany, dané způsobem jejich sbíjení; z metrického hlediska se ovšem často nejedná o čepele, takže jejichž produkce není dominantní (*Nerudová 2002, 25; 2003b, 78*). Na výrobu nástrojů se používaly všechny druhy získaných polotovarů. Nejjednodušší subprizmatická metoda se uplatňovala zejména na ostrohranné bloky surovin s vhodnými úhly mezi plochami, které umožňovaly těžbu čepelových polotovarů přímo, bez rozsáhlých úprav tvaru suroviny. Pro odbití se využíval zejména tvrdý otloukač přímým úderem. Takto bylo možné oddělit z jádra i poměrně pravidelné polotovary.

Mnohem rozvinutější je pak mladopaleolitický způsob redukce jádra, v jehož rámci se upravovala vodící hrana jádra několika údery. Tyto postupy se uplatňovaly i v rámci reparace tvaru jádra a k oddělení polotovarů se využíval i měkký otloukač.

Nejcharakterističtější rysem bohunicieniu je aplikace levalloiské metody *sensu lato*. Pro přípravu jader pro tuto metodu byly využívány zejména hlízy suroviny. Při preparaci tvaru se pozornost soustředila na přípravu podstavy (podstav); příčná a podélná konvexita jádra se upravovala jen minimálně, neboť častěji se využil vhodný přirozený tvar suroviny. Prostřednictvím tvrdého otloukače byly z těchto jader odbíjeny úštěpy, čepele a hroty, někdy i v sériích.

Zvláštní kapitolu představují kombinace několika metod na jednom jádru. Na provedených skládaních se podařilo dokázat reparaci levalloiských jader formou změny orientace těžby z plochy na hranu jádra a následnou těžbou mladopaleolitickou metodou. Jednotlivé metody byly ale na jádru uplatňovány postupně, takže hovoříme spíše o jejich koexistenci. Z vedlejší výzkumové plochy (Stránská skála IIIa) se podařilo složit levalloiské jádro, jehož těžní plocha byla inicializována prostřednictvím vodící hrany (k mladopaleolitické metodě viz *Svoboda – Škrdl 1995, obr. 29.5*). Kombinace levalloiského a mladopaleolitického způsobu sbíjení vedla k úvahám o fúzi těchto dvou metod jako charakteristickým znaku bohunicenské technologie (např. *Svoboda – Škrdl 1995, 435*).

Operační schéma szeletieniu (*obr. 15*) ze studované lokality lze rozdělit na dva hlavní směry: prvním je výroba listovitých hrotů metodou přímého tvarování, druhým je těžba jednoduchých jader buď suprizmatického typu, nebo jader podobných jádrům středopaleolitickým diskoidním. Subprizmatická metoda redukce jádra je založena na vytvoření jednoduché podstavy odbitím vrchlíku z valounové formy suroviny. Následuje série odštěpů z této podstavy. Ty v některých případech odpovídají čepelím a jsou oddělovány z jádra prostřednictvím přímého úderu tvrdým otloukačem (*obr. 7, 8*). Určité odchylky od druhého zmíněného způsobu těžby se projevují ve vícenásobném přeorientování jádra, případně i v existenci odtěžení série polotovarů. Při obou operačních postupech byly získávány více či méně standardizované polotovary, které se následně běžně používaly k výrobě nástrojů (například i listovitého hrotu nebo bifaciálního drasidla z vrchlíku budoucího jádra: *obr. 7: A1*).

Oproti předcházejícím kulturám je aurignacienské operační schéma charakteristické svou uniformitou. Skládáním kamenných artefaktů z lokality Vedrovice 1a se podařilo identifikovat pouze jednu metodu redukce jádra. Tu můžeme označit jako mladopaleolitickou prizmatickou. Vyznačuje se pečlivou preparací úderové plochy jádra, jež je vždy připravená (na rozdíl od pozorování *P. Škrdl 2003, 70* na materiálu ze Stránské skály), a přípravou vodící hrany. Kontrolováním úhlu mezi podstavou a těžní plochou je udržována laterální konvexita jádra. Zřada jader obvykle nejsou preparovaná, resp. nebyla preparovaná u zde popsaných případů. Dálší konvexita jádra je preparovaná v okamžiku, kdy je potřeba těžbu jádra přeorientovat na protilehlou stranu. Z jedno- či dvoupodstavových jader se těžily pravidelné čepelové polotovary, oddělované od jádra přímým úderem měkkým otloukačem. Za nejcharakterističtější jev můžeme považovat opětovné preparování podstavy odbíjením tzv. tablet, které přesně kontrolují úhel mezi těžní a úderovou plochou, ale které zároveň značně redukují délku zpracovávané suroviny. Zdá se, že bude možné považovat tento postup za obecný jev

aurignacienské technologie (Chiotti *et al.* 2004, 284). O technologické úspěšnosti svědčí výjimečná remontáž preparačních a cílových čepelí s úštěpy obnovujícími úderovou plochu (tzv. tablety), dokládající mimořádnou zručnost štípače i v případě hrubší, méně kvalitní suroviny (obr. 12). Z toho můžeme vyvodit, že použitá technologie nebyla ovlivňována kvalitou suroviny jako v případě předcházejících dvou kultur (obr. 15). V budoucnu snad bude možné vyčlenit dvě varianty mladopaleolitické čepelové metody, které poskytovaly čepelové polotovary poněkud rozdílné morfologie. Na jedné straně to jsou přímé čepele s velmi výraznou římsou na patce, na druhé pak čepele drobnějších rozměrů, které jsou silně prohnuté. Jejich patky jsou hladké nebo lomené a také s výraznou římsou. Na možnou koexistenci dvou technik (přímého i nepřímého) získávání čepelových polotovarů již upozornil M. Oliva (1984, 606) na základě analýzy kamenného inventáře z moravských aurignacienských stanic ve vztahu k výsledkům experimentální analýzy (Bordes 1947; Bordes – Crabtree 1969).

Získané výsledky, které definují technologii sbíjení kamenných artefaktů ve třech popisovaných lokalitách, jsou důležité pro přesnější definici vztahů časně mladopaleolitických kultur na Moravě. Otázkou však zůstává, do jaké míry můžeme popsané technologické charakteristiky zobecnit, tj. zda i na dalších lokalitách probíhaly výrobní postupy v alespoň podobných intencích. Přinejmenším v případě szeletienů musíme počítat s určitou variabilitou, spojenou s polohou lokality ve vztahu k nalezištím jiných kultur (bohunicien na Brněnsku) a s funkcí lokality (ateliéry na zdrojích; sídliště). Szeletienké kolekce blíže kontaktní zóně s bohunicienem obsahují i levalloiská jádra a polotovary, jež se vůbec nevyskytují v szeletienkém souboru z Moravského Krumlova IV ani v lokalitě Vedrovice V. Autochtonnost této komponenty bude nutné dále zkoumat formou remontáží takového szeletienkého souboru, který levalloiskou složku obsahuje. Momentálně ale není vhodná kolekce k dispozici. Existenci subprizmatické metody a „diskoidní“ metody v szeletieniu můžeme považovat za dostatečně obecný jev, který může souviset s možným původem této kultury v microquieniu. Rovněž metoda přímého tvarování (fasonáž) bifaciálních artefaktů je obecným znakem, jenž navíc představuje hlavní definiční kritérium.

Technologie bohunicienů patří, vzhledem k dostatečnému množství moderně zkoumaných lokalit, k nejlépe prozkoumaným. V ateliérových polohách se jednotlivé metody opakují. Poněkud odlišně se jeví technologická skladba např. v Brně-Bohunicích, kde se častěji vyskytují i jiné suroviny než jen rohovec typu Stránská skála (rohovec typu Krumlovský les, spongolit apod.) a kde se rovněž objevuje využití metody přímého tvarování v souvislosti s výrobou listovitých hrotů. Jedná se v podstatě o určitý protipól k problematice levalloiské metody v szeletieniu. V budoucnu bude nutné určit, do jaké míry je možné kalkulovat s výrobou bifaciálních nástrojů v neateliérových bohunicienkých lokalitách (Nerudová – Neruda 2004).

Nejhomogennějším dojemem působí technologie aurignacienu. Definované postupy se vícekrát opakují na několika remontážích, takže v rámci sledované lokality lze popsané postupy považovat za obecný jev, i když je asi nutné počítat s určitou variabilitou, nezachycenou prozatím ve skládkách. Momentálně nemáme k dispozici srovnatelné soubory. Podle rozborů industrií v Evropě se ale zdá, že princip opakované úpravy úderové plochy a preparace vodící hrany jádra bude skutečně charakteristickým znakem aurignacienské technologie, která bude lokálně obsahovat i specifické postupy a varianty. Z hlediska techniky odbíjení musíme zřejmě počítat nejméně se dvěma variantami a specifickou složku bude tvořit sbíjení drobných čepelí ze škrabadel a kanelovaných rydel, zejména v souborech s mikrolitickými čepelkami Dufour, příp. Krems (Demidenko 2002).